Bind in both covers.

BRITISH MEDICAL ASSOCIATION,

OXFORD, 1868. 8.

DESCRIPTIVE CATALOGUE

OF

MICROSCOPICAL SPECIMENS,

ILLUSTRATING THE

Structure of certain Tissues and Organs of Man and Animals in Health and Disease,

EXHIBITED AT

THE PRESIDENT'S SOIRÉE,

IN THE

UNIVERSITY MUSEUM, AUGUST 5TH, 1868,

BY

DR. LIONEL S. BEALE, F.R.S.

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8.

MICROSCOPICAL PREPARATIONS

ILLUSTRATING THE

STRUCTURE OF CERTAIN TISSUES

AND

ORGANS OF MAN AND ANIMALS,

IN HEALTH AND DISEASE.

THE present series of preparations includes six of Mr. Bowman's beautiful injections of the kidney, eight preparations of the brain and spinal cord in health and disease by Mr. Lockhart Clarke, and several other specimens made by Professor Frey, of Zurich. My own preparations are intended to illustrate my views upon the general structure and development of the tissues and on the nature of some important changes occurring during disease, and also to show the advantages of certain methods of preparing tissues for microscopical examination.

The magnifying powers are twenty, fifty, one hundred, and two hundred and twenty diameters. The apparent size of $\frac{1}{100}$ or $\frac{1}{1000}$ of an inch when magnified by each of these powers respectively is represented below. By the aid of these scales any one can at once form a notion of the dimensions of the object under examination :—

1–100th of an inch	× 20
,, ,, ,,	× 50
1–1000th of an inch	× 100
,, ,, ,,	× 220

The microscopes have been provided by Mr. Collins, 77, Great Titchfield Street, London, W.

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INDEX TO THE SPECIMENS.

SIMPLE TISSUES.

The following twenty-two specimens illustrate the structure of some of the most important of the tissues in health, and show the varying proportion of the germinal matter to the formed material of the tissues during development and growth at different periods of life, and in health and disease.

In all cases the *formed material*, as tissue or products of secretion, results from changes occurring in the germinal matter. Every kind of texture, secretion, &c. which exists was once in the state of germinal matter. In growing tissues the germinal matter may be seen to be continuous with, and gradually to pass into, the formed material, but when the formation of new tissue has ceased, or is only taking place very slowly, or interruptedly, an interval is often observed which is occupied by fluid. In many cases, the formed material is deposited in distinct layers and appears as a number of capsules or cell-walls one within the other, the inner ones being sometimes puckered or thrown into folds. Numberless are the differences observed with regard to the arrangement, structure, form, and composition of the *formed material*—evidence of original differences of power inherent in different kinds of germinal matter as well as of variations in the external conditions under which the germinal matter lived and died.

1. Fungi stained with carmine, while growing rapidly. The formed material orms an extremely thin layer on the surface. This increases in thickness when growth takes place more slowly. The rapidity of growth is due to the rapid increase of the germinal matter only. Magnified 220.

2. Young cells of growing vegetable tissue, showing the formed material (cell-wall) colourless, while the germinal or living growing matter within is deeply stained with the carmine fluid. Magnified 220.

3. Cuticle of the Newt, showing germinal matter and formed material. The old cuticle exhibiting fully formed cells is seen in the upper part of the specimen. Below this is a portion of young cuticle in which the cells are seen to consist almost entirely of germinal matter, exhibiting as yet but a very thin layer of formed material. Magnified 220.

4. Cuticle of the Frog. Old cells. Lines of oil globules are seen at the lines of junction of the edges of the deep surface of the cells, and are probably situated in narrow spaces which intervene. These are the channels by which nutrient fluid reaches the cells, and are supposed by some to constitute a canalicular system continuous with the blood vessels or the lymphatics. Magnified 220.

5. Cartilage. Ear of the white mouse. This form of cartilage is said to consist entirely of cells, and much resembles some forms of vegetable tissue. The fully formed cells consist of firm transparent formed material, to which alone the physical properties of the cartilage are due, with a small mass of germinal matter. But in the growing cells some of which are seen in the upper part of the specimen, the quantity of germinal matter, in proportion to the formed material, is much greater. Magnified 220.

6. Growing Cartilage from the newt, showing the relation of the germinal matter to the formed material, and the division of the masses of germinal matter where the tissue is increasing in extent. Magnified 220.

7. Ensiform Cartilage. Mouse. In this specimen, cartilage, tendon, and muscle are seen. The formed material of the cartilage is structurally continuous with that of the tendon, and the germinal matter of these textures bears the same relation to the formed material in each case. Magnified 220.

8. Tendon at Birth, showing the rows of oval masses of germinal matter very close together, in consequence of the small amount of formed material yet produced. This preparation should be contrasted with the next. Magnified 100.

9. Tendon of an old man aged 84, showing great amount of formed material produced, in proportion to the germinal matter. In both specimens the oval masses of germinal matter (nuclei, nuclear fibres) of the tendon are well seen. It is evident that they bear the same relation to the formed material, as the germina matter of other tissues. Magnified 100.

* **10. Cartilage** of the frog undergoing conversion into bone. The deposition of calcareous matter in the matrix has commenced, and is gradually surrounding each little mass of germinal matter, which ultimately becomes the so-called nucleus of the lacuna of the fully formed bone. The spaces between the globules of phosphate of lime deposited in the matrix, which are traversed by fluid as it passes to and from the nucleus, become the canaliculi. Magnified 220. *See* also pl. I, figs. 2, 4.

* **11. Bone.** Cancellated tissue of a young pig, showing the germinal matter of the lacunæ well stained with carmine. Magnified 220.

* **12. Development of Permanent Bone.** Femur ; kitten at birth. Below is the soft temporary spongy bone formed by change in the temporary cartilage. Above this is the true bone with its lacunæ, and in the upper part of the specimen is seen the deep layer of the periosteum with the masses of germinal matter by which the matrix of the bone is formed, and which eventually become the so-called nuclei of the lacunæ, seen in this and previous specimens. Magnified 220.

Careful study of specimens of growing bone prepared in the manner recommended (How to Work with the Microscope), will, I think, convince the observer that the germinal matter of the fully formed lacuna of bone represents the germinal matter of the cartilage before its conversion into bone, and that 'ossification' consists simply of the deposition of calcareous matter in granules and globules in the already produced formed material or matrix of the cartilage. Between these globules, channels are maintained by the flow of fluid to and from the germinal matter. They remain in the fully formed bone, and become the canaliculi.

13. Dentine. Human incisor tooth. The masses of germinal matter which take part in the formation of dentine are well seen, and the tissue prolonged from them has been withdrawn from the so-called dentinal tubes, which only become 'tubes' when this soft matter is forcibly torn away or obliterated by desiccation. Magnified 220.

The following six preparations illustrate the development and structure of striped muscle and the changes which occur in fatty degeneration of voluntary muscle.

14. Muscle. Fœtal calf. The distinction between the germinal matter and formed material is well seen. The muscular fibres at this early period exhibit characters which are constant in the leech, earth-worm, and some insects. The contractile material or sarcous tissue is formed upon the surface of the germinal matter and appears as a tube in which the 'cells' lie. Muscular fibres of this character only serve a temporary purpose in man and the higher animals and precede the formation of the ordinary permanent voluntary muscles of the system. These last appear as thin threads and are formed by oval nuclei or masses of germinal matter which are situated on the outside of the fibre. They probably move up and down the fibre and deposit a thin layer of tissue as they go. *See* pl. I, fig. 6. This gradually acquires the character of the muscular tissue already produced. In this way the fibre increases in thickness. Magnified 220.

15. Striped Muscle. Newt. Showing masses of germinal matter of the elementary fibres with the capillaries ramifying amongst them. Magnified 100.

16. Muscle. Pig, at different ages. The fibres to the left are from the pig at birth, and those to the right from a pig three months old. In this short time each elementary fibre has increased to more than twelve times its bulk, and it will be observed that the amount of germinal matter corresponding to a given quantity of tissue is much greater in the youngest muscle. Magnified 100.

17. Muscular Fibres from the white mouse. The capillaries are injected. Many of the oval masses of germinal matter upon the fibre seen between the capillaries belong to the ramifications of the nerve fibres which are too thin and delicate to be followed, except in a few very perfectly prepared specimens. Magnified 220.

18. Muscular Fibres of an insect (Dytiscus). An elementary fibre is seen in the centre of the field which shows the tube of the sarcolemma very distinctly in consequence of the sarcous matter within having been ruptured. In many situations the tendency to split into Bowman's *disks* may be observed, but in this specimen two entire disks may be seen within the tube of the sarcolemma but completely detached from their neighbours. Magnified 220.

19. Fatty Degeneration of Voluntary Muscle. Hyla, or green tree frog. Elementary fibres in an extreme state of fatty degeneration from a muscle which had long been inactive. Magnified 220. *See* also pl. I, fig. 7.

20. Adipose Tissue. From the frog. Showing the manner in which the fat cells are developed from masses of germinal matter. The relation of the vessels to the developing fat and the connective tissue corpuscles are also beautifully seen in this preparation. A bundle of dark-bordered nerve fibres crosses the specimen in the upper part. Magnified 220. *See* also pl. I, fig. 5.

21. Unstriped Muscle from the bladder of the newt, showing the long muscular fibre cells with their large oval masses of germinal matter. The structure of the finest muscular fibre cells is described in prep. 45. Magnified 50. *See* also pl. VI, fig. 29.

22. Unstriped Muscle. Triangular muscular fibre cells from the aorta of the human subject. These much resemble some of the muscular fibre cells of the frog's bladder decribed in prep. 45. Magnified 220.

ARTERIES—TUBERCLE.

The following specimens illustrate the structure of the small arteries in health and some of the changes taking place in disease.

23. Small Arteries and Capillaries from the pia mater of a young man aged 18 years, healthy, showing the muscular fibre cells and the elongated nuclei of the epithelial lining of the artery within. The external areolar coat with the nuclei of nerve fibres is also seen. Magnified 50. *See* pl. I, fig. 8.

24. Developing Vessels from the ovum of the turtle showing also the growth and multiplication of the white blood corpuscles within them. At this

early period very few of the blood globules have yet assumed the form of the oval red blood corpuscles so numerous in the blood of the fully formed animal. Magnified 50.

25. Small Arteries from the pia mater from a case of inflammation of the membranes of the brain occurring in a man, aged 39, who had had an attack of pleurisy, probably tubercular, seven years before. The attack of inflammation of the brain came on after hard work in the garden in a hot sun, and death occurred three weeks after the commencement of the symptoms.

On several branches of the small arteries little eminences are seen. These are the growing 'tubercles.' They are for the most part situated *external* to the muscular fibre cells, and the matter of which they consist seems to have been deposited in the substance of the areolar coat of the vessels. The change gradually spreads from one spot along the vessel until numerous capillaries, small arteries, veins, nerves, and connective tissue become incorporated into one mass, the 'tubercle' of pathologists as it appears to the unaided eye. The minute structure of the 'tubercle' is seen in the next preparation. Magnified 50.

26. Tubercle on a Small Artery from the Pia Mater. Same case as No. 25. The tubercle at this period of its formation, while it is growing actively, is seen to be composed entirely of masses of germinal matter, by the growth and multiplication of which the mass increases in size. With regard to the position of the tubercle, it may be affirmed that it is always situated external to the muscular coat of the artery, in the substance of the areolar coat, or between this and the muscular coat. With reference to its origin, two opinions are tenable.

1. That the tubercle results from increase and multiplication (proliferation) of those masses of germinal matter constituting the connective tissue corpuscles, depending, *a*, upon these being supplied with a peculiar pabulum, or, *b*, upon some unusual activity in one or more of them due to some hitherto unknown circumstances.

2. That the tubercle results from the growth and multiplication of a particle of germinal matter which has passed from the blood through the vascular walls. This perhaps single particle being stationary, and freely supplied with nutrient matter, has soon multiplied and given rise to others like itself, which have invaded the adjacent textures, until the 'tubercle' has resulted. Germs from this might pass to tissues in the neighbourhood, or entering the vascular or lymphatic system, be transported to distant parts to perish, or to form new growths according as the conditions are unfavourable or favourable.

It may be remarked that the position of the tubercle is exactly that in which we should expect to find it, if the latter of the two views were correct, for when the vessel was fully distended, its muscular coat would be in close contact with the areolar coat, and any living germinal matter would pass between the muscular fibre cells and lodge just outside them or in the areolar coat itself. I find in almost all the small arteries affected by tubercle, evidence of prior important changes. The lining membrane is rough, and in many cases the elongated epithelial cells are completely detached, and have collected to form a mass which has become impacted in the vessel. The obstruction thus caused must have led to increased distension of the vessel and thinning of the coats on the cardiac side of the point of obstruc-

tion, a state of things which accounts for the tubercles being developed upon the walls of *small* arteries rather than upon those of the *smallest* arteries, capillaries, or veins. And it is reasonable to conclude that the state of the blood prior to the escape of the tubercle germs would affect the capillary nerves so as to cause, by reflex action, firm and long-continued contraction of the arterial walls. Thus time would be allowed for the germs to pass between the epithelial cells of the small arteries, leading to their detachment, and subsequently to the further changes above described. Magnified 220.

STRUCTURE AND GENERAL ARRANGEMENT OF NERVES.

The next twenty-eight specimens illustrate the structure and general arrangement of nerves, including their origin from the central nerve cells, and their peripheral distribution.

The following eight specimens have been prepared by Mr. Lockhart Clarke ; they show the structure of different parts of the brain, medulla oblongata and spinal cord in health and in certain forms of disease.

27. General Paralysis of the Insane.—Arteries in the vertex-convolutions of the brain. These arteries are either tortuous or looped and surrounded by masses of hœmatoidin lodged in the secondary sheath. Magnified 100.

28. Normal Nerve-Cells of the Olivary Body from the human medulla oblongata. They are rather small, and globular, oval, or pyriform, with numerous processes. Magnified 100.

29. Gouty Paralysis.—Atrophy of the nerve-cells of the olivary body. In different parts of the convolution the nerve-cells are in different states of atrophy and disintegration. In some places they have fallen into separate granules which are scattered through the lamina ; in other places, they are reduced only to small heaps of granules ; while here and there, one or more of the cells retain their normal or nearly normal appearance. Magnified 100.

30. Normal Nerve Cells in the anterior horn of the gray substance of the human spinal cord. Coloured with carmine. Magnified 100.

31. Muscular Atrophy.—Atrophy of the nerve-cells of the spinal cord. Almost all the cells are shrivelled or shrunk to small irregular bodies which cannot be distinguished from the numerous connective tissue corpuscles with which they are mixed. Coloured with carmine. Magnified 100.

32. General Paralysis of the Insane.—Areas of granular disintegration in the gray substance of the spinal cord. Magnified 100.

33. Chorea.—Areas of granular disintegration of the posterior horn of the spinal cord of a girl. One of the areas is oval, the other a long tract at its side. The preparation is coloured with carmine. Magnified 100.

34. Traumatic Tetanus.—Fluid and granular disintegration of nearly all the central gray substance of the spinal cord. Along the borders of the transparent fluid space the gray substance may be seen in process of disintegration and

solution ; and in the midst of the fluid area, small masses or islets of the gray substance may be seen undergoing the same destructive alteration. Magnified 100.

Although some of the most important points to be demonstrated in some of the next specimens are almost invisible under a magnifying power of less than from 700 to 1,000 linear, facts of considerable interest may be made out under lower powers.*

35. General arrangement of Nerves in the Nerve Trunks, and Distribution of the finer Peripheral Ramifications. Branching and subdivision of fine nerve trunks in areolar tissue. Branches of small vessels injected with Prussian blue are also seen in various parts of the specimen. The small masses of germinal matter all over the field are the so-called connective tissue corpuscles. It will be observed that when a branch of nerve comes off at right angles from the trunk, the fibres constituting the branch proceed in opposite directions in the trunk. *See* figs. 12, 13. Magnified 100.

36. True skin of the Hyla or Green Tree Frog, showing arrangement and branching of the finer ramifications of the nerve trunks, and the formation of numerous plexuses or networks. The number of individual fibres is far greater in the finer ramifications than in the larger trunks, because the dark-bordered fibres divide and subdivide very freely as they approach their peripheral distribution. One dark-bordered nerve fibre probably divides into more than a hundred finer ramifications, some of which continue to exhibit the dark-bordered character for a further course, while others soon become the fine pale fibres of ultimate distribution. A diagram of the peripheral arrangement of the ultimate nerve fibres in the skin is given in fig. 10. Magnified 100.

37 Division of Nerve Trunks, and formation of series of networks and plexuses from the edge of the eyelid of the frog. *See* fig. 12. Magnified 220.

38. Distribution of fine dark-bordered Nerve Fibres, to the mucous membrane of the nose of the mole. Magnified 220.

39. Distribution of fine Nerve Fibres and Vessels, in connective tissue. Frog. The vessels are not injected, but are, nevertheless, very distinctly seen. Branches of the nerves may be traced in many places to the vessels. Magnified 220.

40. Distribution of fine pale Nerve Fibres in areolar coat of a very small artery. From the hyla or green tree frog. The pale nucleated fibres divide and subdivide, forming a network or plexus around the artery. The fibres ramify in the connective tissue forming the external coat of the vessel. *See* fig. 11. Magnified 220.

41. Ultimate Distribution of fine pale nerve fibres to voluntary muscle. Frog. In the centre of the field is seen a branching muscular fibre, the fibres

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* Arrangements will be made for the examination of certain specimens under higher powers after the soirée.

resulting from the subdivision of the muscular trunk, gradually taper into thin threads, which are inserted into the connective tissue. Networks of pale nerve fibres are seen in all parts of the preparation, but the muscular tissue has been removed. Magnified 220.

One part of this specimen is represented in pl. III, fig. 15, and the distribution of nerves to one of the capillaries more highly magnified in fig. 14.

* **42. Division and Branching** of fine nerve trunks, and distribution of fine pale fibres to capillary vessel. The portion of the specimen under the microscope is the interval between two portions of a muscle (voluntary) from the neck. Magnified 220.

Part of this specimen is represented in pl. IV, fig. 16. In this and several other specimens, the fact of the existence of nerves to the capillary vessels is positively demonstrated. I have elsewhere adduced reasons for concluding that these with the fine fibres ramifying in the proper tissue of the cornea and other fibrous textures, those around the uriniferous tubes and various gland follicles, &c., constitute the afferent portion of the system, to which belong as efferent branches the so-called *vaso-motor nerves* distributed to the arteries. These two sets of fibres with the ganglia common to both, constitute the self-regulating mechanism, by which in health the equable flow of nutrient matter to the various tissues and organs of the body is maintained, and through which any temporary disturbances are at once corrected or compensated for. Anatomical observation does not justify the conclusion so generally accepted, that there is a special system of nerves presiding in some mysterious way over the actual processes of nutrition and action, going on in each individual cell. And many of the facts taught us by experiments on living animals receive a more satisfactory explanation upon my view. For instance, there is the interesting observation on the foot of the living frog. If a small artery be brought into the field of the microscope, it may be made to contract violently, by gently touching the surface, even at a considerable distance from the point where the small artery is situated. In this experiment, the afferent fibres are irritated, an impression is carried to the nerve centre, and by the disturbance produced the efferent fibres are excited, and contraction of the artery results.

In disease, the action of this self-regulating nerve mechanism is deranged ; in lasting organic disease it may be permanently impaired, or in parts completely destroyed.

* **43. Fine Nerve Fibres distributed to the Cornea.** Hyla. In this specimen numerous networks of extremely fine nerve fibres are seen in the substance of the corneal tissue. Most of the masses of germinal matter in every part of the field belong to the corneal tissue, and are the so-called connective tissue corpuscles, but oval masses of germinal are also seen in connection with the nerve fibres. *See* fig. 17. The nerves are not continuous with the branches of the connective tissue corpuscles as Kühne supposed, nor do they give off numerous branches to the epithelium of the conjunctiva, as recently stated by Cohnheim. Magnified 220.

The four following specimens are from the bladder of the newt or frog, and illustrate the arrangement of the muscular

fibre cells, vessels, and nerve fibres. The extreme thinness of the membrane renders this tissue very favourable for studying the arrangement of the finest nerve fibres and their relation to the vessels, to the muscular fibre cells, and to the surface of the mucous membrane just beneath the epithelium.

44. Bladder of the Frog. Showing the bundles of muscular fibre cells passing in every direction, and numerous extremely fine muscular fibre cells occupying the spaces between the bundles. The vessels are injected with blue. Magnified 50 diameters.

45. Bladder of the Frog. Showing the numerous muscular fibre cells traversing the spaces existing between the bundles referred to in the last specimen. Many of these have contractile filaments radiating in three directions from the triangular nucleus. By the contraction of these, it is obvious that the area of the membrane must be reduced in every direction. Magnified 220.

* **46. Bladder of the Frog.** Part of a ganglion and nerve fibres. A small artery runs to the left of the ganglion and a capillary crosses it. The ganglion cells are coloured with carmine and are distinctly seen. Magnified 220.

* **47. Bladder of the Frog.** Showing fine pale nerve fibres ramifying amongst the tissues. These nerve fibres are extremely delicate, but their course may be readily traced by the lines of minute oil globules which have been formed by the slow and prolonged action of acetic acid on them. Magnified 220. In pl. V, fig. 22, the manner in which the fine fibres are given off from the dark-bordered nerve fibres is represented. *See* also figs. 23, 29, pl. VI.

* **48. Distribution of dark-bordered Nerve Fibres** to the pectoral muscle of the frog. The continuations of the dark-bordered nerve fibres as fine pale fibres with nuclei in the intervals can be clearly demonstrated in this specimen. Kölliker thinks these soon cease and thus form *ends*, pl. V, fig. 24, but in my specimens they may be followed much further than Kölliker has succeeded in tracing them, and observations upon other muscles of the same animal render it almost certain that these very fine nucleated fibres come into close contact with the sarcolemma and ramify over every part of the surface of the elementary fibre. Magnified 220.

* **49. Distribution of Nerve Fibres to the Elementary Muscular Fibres.** Chameleon. The individual muscular fibres are separated from one another by more than their diameter so that the finest nerve fibres can be seen in the intervals between them and traced over or under them without difficulty. In this specimen many of the so-called 'nerve tufts' can be discerned, but in almost every instance more than one individual nerve fibre can be traced to the tuft, and it seems more probable that the tuft consists of continuous fibres, much coiled and convoluted, than that it is a terminal organ connected with the end of an individual fibre. From every one of these 'nerve tufts' fibres may be traced and followed for a considerable distance over many muscular fibres beyond. Magnified 220. The arrangement will be understood if figs. 25, 26, 27, and 28 be carefully studied. There are no ends or terminations whatever. These figures as well as

figs. 31, 32, and 33 may be compared with Kühne's drawings, figs. 18, 19, 20, and 21, and Kölliker's fig. 24, in all of which the nerve is supposed to end.

To Kühne is undoubtedly due the merit of having observed the so-called *end plates* or end organs in voluntary muscle, and it is not surprising that he should have been led to regard them as the special nerve organs of this tissue. He has studied principally large muscular fibres, and considers these most favourable for observation, but it seems not to have occurred to him that in consequence of the refractive power of the contractile tissue, the finer nerve fibres may be completely obscured. I do not think he has yet formed the slightest idea of the general arrangement and great number of the fine nerve fibres in voluntary muscle, as may be demonstrated, for example, in the delicate mylohyoid muscle of the hyla, pl. VIII. At least in the chameleon several fibres are to be seen passing *to* and *from* each nerve tuft, but Kühne has only figured a single dark-bordered fibre entering the tuft. These 'tufts' may be compressed nerve loops or networks, but they cannot be *end organs*. In them the nerve does not end. *See* figs. 25, 26, 27, 28, pl. VI. It seems to me most probable that these bodies are exceptional and not present in all muscles, nor essential to voluntary muscle generally. As in other tissues the peripheral arrangement of the nerves in voluntary muscle is a continuous network, in which the nearest approach to an 'end' or 'termination' is a loop. *See* figs. 31, 32, 33. Kühne is also wrong in concluding that the nerve tuft is situated beneath the sarcolemma and in contact with the contractile tissue. Like many of the nerves these bodies adhere to the sarcolemma, but are certainly not in intimate relation with the contractile material of the muscle. In pl. VI, 'nerve tufts' exhibiting various degrees of complexity are represented. The course of the exceedingly fine nerve fibres can be followed and their connection with the nuclei demonstrated. The general conclusions I have arrived at from investigating the structure of these bodies accord very closely with those resulting from investigations upon other tissues.

* **50. Ultimate Distribution** of finest nerves as networks and plexuses in the mylohyoid muscle of the hyla or green tree frog. These fibres are very narrow, and at the same time each is separated by a distinct interval from its neighbours. *See* pls. VII and VIII, figs. 30, 33. The state of things is, therefore, very favourable for the observation of the oval end organs if they are present. I have never been able to discover one in this beautiful example of voluntary muscle, though I have found them in many other specimens of muscle. Nerve fibres may be traced for an immense distance from the bundles of dark-bordered fibres. Gradually they become less than the $\frac{1}{100000}$ of an inch in diameter, figs. 31, 33, but still divide and subdivide into fine threads with oval nuclei at intervals, now running parallel with the muscular fibre, then crossing it, dividing into branches, some of which after pursuing a very long course may at last be traced to a dark-bordered fibre in another part of the muscle. I have succeeded in doing this in many different specimens, but other observers have failed to confirm my observations, as regards voluntary muscle, although they admit their correctness in the case of involuntary muscle. The failure of others to obtain specimens exhibiting the same appearances no doubt depends upon a very different method of investigation having been pursued. Anatomists in Germany have not only failed

to observe what I have seen but they have not succeeded in demonstrating the fine pale nucleated fibres I have demonstrated in almost every tissue in the frog. Magnified 220.

My friend Kühne, of Amsterdam, is one of the foremost in condemning the conclusions I have arrived at concerning the general arrangement of nerve fibres, and although he has not seen the fine fibres above referred to, he expresses himself most positively, and at least as regards the nerves of voluntary muscle, as if it were absolutely certain that he alone was right. But Kühne has himself propounded three or four different views. The first and the last differ very widely. One would have thought that the freedom exercised by him in altering his own views (compare fig. 18 with 19, 20, and 21), would have been charitably extended towards others ; but he speaks as if he were an infallible anatomical authority dictating the only true faith.

It has been maintained that in voluntary muscle a dark-bordered fibre as wide or wider than the muscular fibres in the mylohyoid of the green tree frog, may pass direct to the terminal organ (*see* fig. 20, pl. IV), while on the other hand, it is admitted that in the involuntary muscle extremely fine nerve fibres—far finer than any seen by Kühne in voluntary muscle, exist, pl. VI, fig. 29. My preparations seem to show that the nerve fibres in voluntary and in involuntary muscle possess the same general arrangement, and are equally delicate. If we accept the conclusions now most favoured in Germany, we must admit that the distribution of nerves to voluntary muscle is far less elaborate than to the involuntary muscular fibre, in the face of the fact that as an elaborate working machine the former is beyond all comparison superior to the latter. Anatomists in Germany make out that of all tissues, voluntary muscle receives in a given area the fewest nerves, while to a single epithelial cell many fibres are supposed to be distributed ;—in short that a tissue which we know to be eminently under the influence of the nervous system in every part receives very few nerves as compared with such a body as an epithelial cell of a glandular organ. As every one

well knows, the structure and action of voluntary muscle actually depend upon the state of the nerves, but at least in very many cases the most complex secretions are formed without the existence of a nervous apparatus at all. Nevertheless, many anatomists profess to prove an abundant distribution of nerves to the tissue concerned in secreting operations, while they assert that a large portion of the contractile tissue of muscular fibre is altogether destitute of nervous supply.

The fine pale nucleated nerve fibres which I was the first to describe, exist in all tissues, and constitute the active part of every peripheral nerve apparatus. Certain appearances have very recently led some anatomists to the conclusion, that these very fine nerve fibres give off still finer ones, which become continuous with the processes of the connective tissue corpuscles, the tails of epithelial cells, or pass into these bodies in considerable number, or terminate in fine free extremities ; but I think this view will prove to be incorrect. When I first studied the arrangement of the fine nerve fibres, I was myself led towards a similar conclusion, but subsequent more careful observations upon well-prepared and exceedingly thin specimens of tissue examined with the aid of the $\frac{1}{25}$ and $\frac{1}{50}$, convinced me that the nerve fibres did not enter or become continuous with the above structures ; and although there is still much doubt on several questions of detail, with regard to the arrangement of the finest nerve fibres in some special organs, new facts demonstrated from time to time, confirm me in the truth of the general views I have advanced on the arrangement of nerves in peripheral organs. That an observer should assert that in muscle the dark-bordered nerve fibres end almost abruptly in the nerve plates, and yet hold that in other tissues the ultimate nerve fibres are so minute that many pass into a single epithelial cell is most remarkable, but nevertheless many German anatomists, having great authority undoubtedly, maintain that there is nothing inconsistent in accepting both statements, an opinion which could not, I think, be adopted by any one who had seen in several different tissues of the frog

or newt the fine ramifications of the pale nucleated nerve fibres.

GANGLIA, AND THE STRUCTURE OF THE CENTRAL NERVE CELLS WITH THE STRAIGHT AND SPIRAL NERVE FIBRES WHICH PASS IN OPPOSITE DIRECTIONS.

* **51. Ganglia in the Sub-Mucous Areolar Tissue of the Small Intestine.** Ileum of the human subject. These ganglia are extremely numerous in the sub-mucous tissue of the alimentary canal of all mammalia. Magnified 220. *See* also fig. 37.

52. Ganglion from the Pelvis of the Kidney of a young Pig. Connected with the nerves in the pelvis of the kidney are numerous ganglia from which bundles of nerve fibres pass to be distributed to the cortex. The fine nerve fibres of the kidney are distributed to the vessels and also to the uriniferous tubes. Magnified 100. *See* figs. 38, 39, 41.

* **53. Ganglion Cell with Spiral and Straight Fibre** proceeding from it. From the hyla or green tree frog. Magnified 700. The cells of which this is an excellent example have been fully described in my memoir "On the so-called Apolar, Unipolar, and Bipolar Nerve Cells of the Frog." Phil. Trans., 1863. The general structure is represented in fig. 34, from the cell under the microscope. *See* also figs. 35, 36, and 40, which represent other cells of the same kind.

* **54. Large Triangular Caudate Nerve Cells** from the medulla oblongata of the dog. Lines which upon examination with a higher power are seen to be here and there interrupted, traverse the cell in every part of its extent, crossing each other in almost every direction. These lines may be followed from one fibre, traced across the cell into each of the other fibres which emerges from it. It is evident that the fibres have the same structure and composition as the material of which the body of the cell consists. The lines in question indicate, I think, the paths taken by the nerve currents which traversed the cells. Magnified 220.

PREPARATIONS ILLUSTRATING THE ANATOMY OF THE LIVER IN HEALTH AND DISEASE.

The following twenty preparations show various points of interest in the structure of the liver of vertebrata. The majority illustrate the view I advanced many years since concerning the origin and arrangement of the ducts "On the ultimate arrangement of the biliary ducts," Phil. Trans., 1855. Since that memoir was published, very many papers have appeared in Germany, in which other views are advanced or advocated. The majority of observers seem to have accepted the strange doctrine that each individual liver cell is sur-

rounded by very minute ducts or biliary capillaries, so that the bile after its formation by the liver cells must pass in the first instance through the cell wall and then through the wall of the duct. This view of the structure of the liver is utterly at variance with all conclusions deduced from analogy. Such a structure does not exist in the liver of the lower animals nor in any other glandular organ known. More recently, Hering has admitted that the view advanced by me is essentially true in the case of fishes and reptiles; but he asserts that in birds and mammalia there exist channels (the so-called bile capillaries which others had affirmed possessed distinct walls) between the cells, many of which exhibit grooves for the passage of the bile. Is it, I would ask, in the least degree probable that the liver of the two lower orders of vertebrata should be constructed upon one principle, and those of the two higher orders upon a totally different principle, while the general arrangement of other textures of the organ,—the veins, arteries, and ducts are the same in all vertebrate livers? This idea of the cells being grooved on the surface for the passage of the bile is surely a very artificial one. Its supporters seem to look upon the cells as bricks or stones in a wall, upon the surface of which grooves have been cut to permit the passage of fluid from them, without considering how such brick-like bodies became placed as they are, and how their surfaces come to be grooved. Many of the drawings of hepatic structure given in support of this view look more like mere diagrams than careful copies from nature. The arguments advanced by me in favour of the existence of a tube of membrane in which the liver cells lie have not even been considered by many of those who have written since, and I am sure few have even seen my drawings. The conclusions arrived at from allowing the injection to pass into the narrow spaces between the cells and the walls of the tube, are as well explained according to my view as according to that which is accepted. The appearances of the cell containing network when the tubes are properly filled so that the injection completely surrounds the cells may be studied

in preps. 61, 63. But the specimens of cirrhose liver seem to put the question of the existence of the tubular cell containing network at rest, since no one can question the presence of such a structure in this disease, preps. 70, 71. If the development of the liver be properly worked out as is not difficult in the frog and toad, the cell containing network in different stages of growth can be demonstrated (preps. 67, 68), and appearances seen less distinctly in the young mammalian liver are in favour of the same view.

55. Human Liver. Vessels in a small portal canal. *Portal vein*, white. *Hepatic artery*, red. *Duct*, black. Magnified, 20.

56. Liver, Ox. Showing the arrangement of the lobules. *Portal vein*, red. *Hepatic vein*, blue. In many places the red and blue injection is seen to meet in the capillaries. It will be observed that there is no distinct separation between the several lobules, but the capillaries of one lobule are continuous with the capillaries of adjacent lobules. Magnified 20.

57. Liver, Pig. *Portal vein*, blue. It will be observed that the lobules are completely separated from one another. Each is surrounded with a capsule. The vessels run in the intervals between the lobules. The capillaries of one lobule are not continuous with those of neighbouring lobules as is the case in the human and most other vertebrate livers. Magnified 20.

58. Liver, Guinea-Pig. *Hepatic vein*, red. *Portal vein*, blue. *Duct*, imperfectly injected, yellow. Prepared by Prof. Frey, of Zurich. As the specimen has been dried, the injection has shrunk so that the vessels appear much narrower than they do in recent specimens, or in those preserved in fluid. The capillaries of one lobule communicate with those of neighbouring lobules. Magni. fied 50.

59. Liver, Sheep. *Duct*, injected blue. The general distribution of the duct to the lobules is well seen in this specimen. Branches reach every lobule at different points of its circumference, and then divide into smaller branches. Magnified 20.

60. Liver, Human Fœtus. *Ducts*, injected. Showing networks of ducts, and the way in which free communications are established between all the ducts and different points of the same duct. Magnified 20. *See* also pl. XII, figs. 46, 47, 49.

60*a*. Vasa Aberrantia, from the transverse fissure of the human liver, injected blue. Branches of the artery are seen, injected red. Magnified 20.

* **61. Liver, Human Subject.** Showing the manner in which the finest branches of the duct divide and subdivide to form the *cell containing network* of the lobule. The injection is seen in the duct, and *amongst the cells lying in the tubes of the network*. The bile secreted by the liver cells passes from these directly into the ducts, just as saliva secreted by the cells in the follicles of the salivary glands, passes into the ducts continuous with them. According to this view, the liver

has the essential structure of an ordinary gland. Magnified 220. *See* pl. XIII, fig. 53.

* **62. Liver, Rabbit.** *Duct,* blue. *Portal vein,* red. A preparation made by Prof. Frey, of Zurich. This specimen shows that injection passes from the gall ducts into channels between the liver cells and between these and the walls of the tube in which they lie. These channels are considered to be biliary capillaries continuous with the duct, and are supposed to surround each individual liver cell. It is supposed that the cells lie free in the meshes of the capillary network, and not within a tubular extension of the duct as is now admitted to be the case in the invertebrate liver, and in the livers of fishes and reptiles.

It seems to me that in this specimen the injeetion is imperfect, and that if a little more force had been employed, the colour would have surrounded many of the cells instead of being confined to the spaces between them. It is obvious that the appearances seen in this preparation can be explained fully according to my view of the structure of the liver, as well as upon that adopted by most German observers, while it is impossible to account for the appearances seen in my specimens, on the supposition that bile capillaries ramify outside the hepatic cells. Magnified 220.

* **63. Human Liver.** Duct injected blue. Cell containing network fully distended with injection. The outline of the walls of the tubes in which the liver cells lie are very distinctly seen and it is considered that this specimen demonstrates conclusively the arrangement of the secreting structure of the human liver and its connection with ducts. Magnified 100.

64. Human Liver showing tubes of the cell containing network near the central part of the lobule. The hepatic vessels were much distended and the intervening tubes compressed in corresponding degree. This narrowing of the tubes renders them unusually distinct and enables us to see that they form a veritable network which alternates with the capillary network. Portal vein imperfectly injected. Magnified 50.

65. Human Liver. Portion of the same specimen as No. 64. Showing the tubes of the cell containing network very distinctly. Magnified 220. *See* pl. XI, fig. 44.

66. Liver, Human Fœtus. Showing tubes of the network with secreting cells within. In this specimen it is seen that the secreting structure of the liver is really contained within delicate tubes, and it is proved that the cells do not lie free amongst the capillaries. Magnified 220.

67. Liver, Toad. Showing the manner in which the cell containing network is developed as a diverticulum from the duct, proving that the cavity of the secreting part of the gland is directly continuous with that of the ductal portion. Magnified 220.

68. Liver, Toad. Showing the further development and extension of the tubes of the cell containing network. The outlines of the individual tubes and the intervals between them are beautifully distinct. Magnified 100.

69. Cirrhosis of the Liver. Advanced case. Showing wasting of the lobules commencing at the circumference, and corresponding increase in extent of the so-called interlobular spaces. The branches of the portal vein have been

injected with Prussian blue and the injection has passed into the capillaries occupying the central part of the lobules which alone remains.

The colourless tissue lying between the lobules usually regarded as fibrous tissue, the supposed thickened capsule of Glisson, is seen to be highly vascular, and even by the low power the remains of tubes having a granular appearance are seen amongst the vessels. This so-called *interlobular* fibrous tissue is in fact *lobular* and consists merely of the altered outer part of the lobules as is proved by this and the following specimen in which the tubes of the cell containing network are very distinctly seen. Magnified 20.

70. Cirrhosis of the Liver, more advanced than specimen 69, showing the remains of one lobule, while several adjacent lobules have completely wasted. The supposed *interlobular fibrous tissue* is seen to contain a great number of tubes, the shrunken and wasted tubes of the cell containing network of the lobule. Magnified 50. *See* also pl. XIV, fig. 50.

71. Cirrhosis of the Liver. From the same specimen as prep. 69, but more highly magnified, in order to show the wasted tubes of the cell containing network more distinctly. The shrunken cells can be seen in many of the tubes. The whole of the texture in the field of the microscope has been considered to be thickened Glisson's capsule and has been described as fibrous tissue, but it is evident that such a description is very imperfect. Magnified 100.

72. Human Gall Bladder. Artery red. Portal vein white. Magnified 20. *See* also pl. XI, fig. 43.

73. Lymphatics ramifying on the surface of the liver of the ox injected with Prussian blue. Magnified 20.

74. Lymphatics ramifying upon the surface of the vessels in the portal canals, injected with Prussian blue. From the liver of the ox. Magnified 20. *See* also pl. XI, fig. 42.

For drawings of the structure of the liver *see* pls. XI, XII, XIII.

PREPARATIONS ILLUSTRATING THE STRUCTURE OF THE KIDNEY.

Specimens seventy-five to eighty were made by Mr. Bowman before the year 1842, and illustrate his well-known memoir on the "Structure and uses of the Malpighian bodies of the kidney," published in the Phil. Trans. for 1842. They have been kindly lent by him for exhibition among this series of preparations.

75. Kidney, Boa. Artery red, uriniferous tubes white. The tubes have been injected from the ureter, which ramifies on the surface of the lobes. Magnified 50. Prepared by Mr. Bowman.

76. Kidney, Horse. Artery yellow. The capillaries of the Malpighian body have been ruptured and the injection has passed into the uriniferous tube. Prepared by Mr. Bowman. Magnified 50.

77. Kidney, Guinea Pig. Injected from the renal artery. The injection has passed into the capsule of the Malpighian body from the capillaries and filled the upper part of the tube. Prepared by Mr. Bowman. Magnified 50.

78. Kidney, Man. Surface. The injection has extravasated from the capillaries of the Malpighian body and distended the tube. Coils of injected uriniferous tubes are seen in many different parts of the specimen. Magnified 50. Prepared by Mr. Bowman.

79. Kidney, Man. Uriniferous tubes injected from the Malpighian bodies. The artery was injected with yellow. The vein red. Prepared by Mr. Bowman. Magnified 50.

80. Kidney, Man. Surface. Malpighian bodies and tubes yellow. Veins red. Injected by Mr. Bowman. Magnified 50.

81. Straight Vessels or vasa recta coming off direct from small branches of the renal artery, human subject. In this specimen a great number of these vessels, which have the ordinary structure of minute arteries, may be demonstrated. Magnified 20. *See* also pl. XIV, fig. 57.

* **82. Kidney.** Malpighian body with diverticulum. Female newt. This structure is now shown for the first time. It is remarkable that in the case of the youngest Malpighian bodies it is very near the neck of the tube, but as the organ grows the distance between the neck of the tube and the diverticulum gradually increases. Magnified 220. *See* also pl. XIV, fig. 56.

83. Kidney. Thin upper portion of the kidney of the male newt (Triton cristatus), showing Malpighian bodies and tubes, and the origin of the Malpighian bodies from a tube common to all in the upper part of the kidneys. Magnified 50. *See* also pl. XIV, figs. 58, 59.

84. Kidney. Thin upper portion, male newt, showing Malpighian body with tuft of vessels, intertubular capillaries and course of uriniferous tube. Nerve fibres distributed to the tube may also be demonstrated in this specimen. Magnified 50. *See* also pl. XIV, figs. 59, 60.

84*a*. Kidney Male newt, showing a doube Malpighian body. Magnified 100. *See* fig. 58 above *a*.

COMPOUND TISSUES PREPARED IN DIFFERENT WAYS.

* **85. Skin of Frog,** showing epithelium, cutaneous glands, pigment corpuscles. Vessels injected blue. Magnified 100.

* **86. Palate of Frog,** showing capillaries with curious lateral pouches and epithelium on the surface. The nerves are well seen in this specimen when examined under higher powers. Magnified 100.

87. Villi and Lieberkuhn's follicles. Small intestine of man—stained with carmine, but not injected. Magnified 50.

88. Villi. Small intestine of dog. Vessels injected. Prepared by Prof. Frey, of Zurich. Magnified 50.

89. Colon of Rabbit. Lacteals injected with red. Magnified 50. Frey.

90. Glands, Vermiform Appendix, rabbit. Vessels, blue. Lacteal, red. Magnified 50. Prepared by Prof. Frey.

91. Corpus Luteum, from the human ovary, one month after delivery. Vessels injected. Mr. Parkes, of Birmingham. Magnified 15.

URINARY DEPOSITS.

92. Uric Acid. Large crystals mounted as opaque objects, and seen by reflected light. Magnified 50.

93. Uric Acid. Large crystals. Magnified 50.

94. Uric Acid. Large rhomboidal and six-sided crystals. Magnified 50.

95. Uric Acid. Rhomboidal crystals with sharp edges, and in groups. Magnified 50.

96. Uric Acid. Halbert-shaped crystals. Magnified 50.

97. Uric Acid. Peculiar form of colourless crystals. Specimen sent by Dr. Munroe, of Hull. Magnified.

98. Uric Acid. Curious form of crystals forming small four-sided pyramids. Magnified 100.

99. Oxalate of Lime. Octahedra and small oval and dumb-bell crystals of oxalate of lime in Canada balsam. Magnified 220.

100. Oxalate of Lime. Octahedra and dumb-bells with some six-sided crystals, from a specimen sent by Mr. B. Wills Richardson, of Dublin. Magnified 220.

101. Oxalate of Lime. Octahedra with a few dumb-bells. Magnified 220.

102. Phosphate of Lime from urine. Magnified 100.

103. Cystine in six-sided crystals. Magnified 100.

104. Carbonate of Lime from the urine of the horse. Magnified 100.

105. Leucine obtained from the urine in jaundice. The urine is concentrated by evaporation, and the leucine slowly crystallises out. Magnified 220. *See* also pl. XVI, fig. 63.

106. Casts.—Mucus casts impregnated with dark urates from a case of the so-called intermittent hæmaturia. These casts do not indicate chronic renal disease, but may be produced in any case in which the kidney is irritated. They are sometimes found in cases of renal calculus. Magnified 220.

107. Casts.—Large waxy and casts containing altered epithelium and probably white blood-corpuscles from a case of chronic inflammation of the kidney. Magnified 220. *See* also pl. XV.

108. Calculi. Microscopic renal calculi passed in immense numbers in the urine of a gentleman suffering from symptoms of renal calculus. They are composed of oxalate of lime and are insoluble in acetic acid and liquor potassæ. The remains of cells probably derived from the uriniferous tubes are to be seen in some of them. Others are but rather large dumb-bell crystals of oxalate of lime. Magnified 220. *See* also pl. XVI, fig. 64.

109. Cancer Cells passed in the urine of a patient suffering from cancer of the bladder. The cells were very abundant in the urine, and many contained daughter cells and numerous nuclei. Magnified 220.

110. Sarcinæ ventriculi from vomit. These bodies are particularly numerous and well developed in this specimen. Part of a muscular fibre, altered starch globules and collections of crystals of fatty acid are seen in various parts of the field. Magnified 220.

111. Lung Tissue found in the sputum of a patient in the early stage of phthisis, before any physical signs indicated the existence of a cavity, and before the general health or nutrition of the patient had become affected. Magnified 220. *See* also pl. XIV, fig. 61.

112. Crystals of Hæmatoidin in an altered blood clot removed from a very small artery from the brain which was quite plugged. The lining membrane of the artery has been torn out with the clot. Magnified 220.

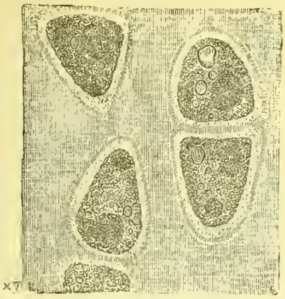
ILLUSTRATIONS.

In selecting the following drawings, as well as in choosing the specimens, I have purposely taken those which illustrate some of the most interesting points in connection with the structure and arrangement of tissues, and it unfortunately happens, that on many questions of fundamental importance I have been led to form conclusions strangely at variance with those entertained by German observers of high repute and great authority. But as my conclusions are for the most part based upon appearances observed over and over again in many different animals, I have every reason to think they will receive confirmation ere long, at the hands of others. In many cases the specimens have been preserved, so that I have seldom to resort to the unsatisfactory excuse of not being able to show what I profess to have seen, because the specimen will not keep. In some instances, the only information possessed by my opponents concerning my views, seems to have been obtained second hand from reviews, and my work has often been criticised by those who have never seen my drawings. These are only some of the many disadvantages under which those who study minute anatomy in this country labour. Our work here is unpopular, and considered by many occupying high positions in the profession, useless ; although one would think it must be obvious to any thoughtful person that the first principles upon which the true medicine of the future must be based, can only be established by careful anatomical investigation. In a short time, good treatises on medicine and pathology will be almost unintelligible to those who are unacquainted with the minute anatomy of the most important tissues and organs of the body. It therefore becomes the duty of teachers to show the real importance of this subject, and advocate its claims as an essential part of medical education. With the view of saving the student

as much trouble as possible, I have always endeavoured to supersede lengthy description by illustration, and venture to think that if the following drawings be attentively studied the reader will acquire almost at a glance, and with the expenditure of very little time, a knowledge of some of the conclusions arrived at on certain anatomical questions of great interest and importance, which could at best be but imperfectly conveyed by description. And it is hoped that by a careful consideration of the drawings, the examination of the actual specimens will be facilitated, and the points to be noticed, brought prominently under the attention of the observer.

HARRISON AND SONS, PRINTERS IN ORDINARY TO HER MAJESTY, ST. MARTIN'S LANE.

Fig. 1.



Cartilage, frog, showing germinal matter and formed material. × 700.

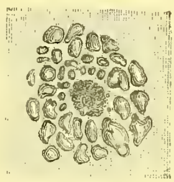
Fig. 2.

Gradual conversion of cartilage into bone and formation of lacuna. Frog. × 700.

Fig. 3.

Young cartilage cell showing relation of germinal matter to formed material. × 1300.

Fig. 4.

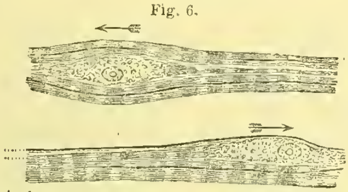


Formation of canaliculi in bone.

Fig. 5.

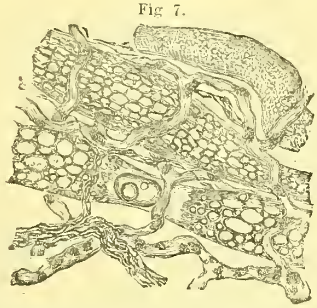
Formation of fat from germinal matter. Frog. × 700.

Fig. 6.



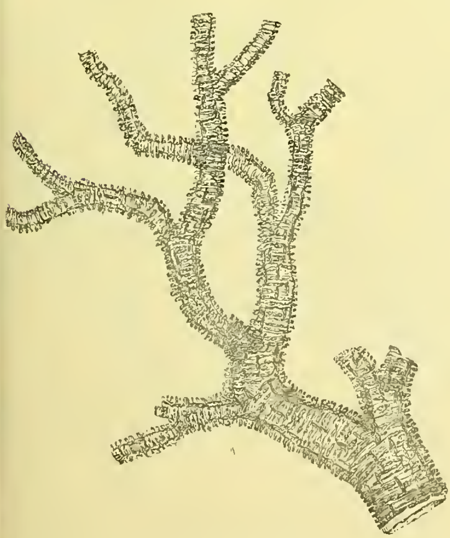
Germinal matter of voluntary muscle, showing mode of formation of formed material. The masses of germinal matter are supposed to move in the direction of the arrows.

Fig. 7.



Fatty degeneration of voluntary muscle. Frog. Branches of vessels and nerves are also seen. × 215.

Fig. 8.



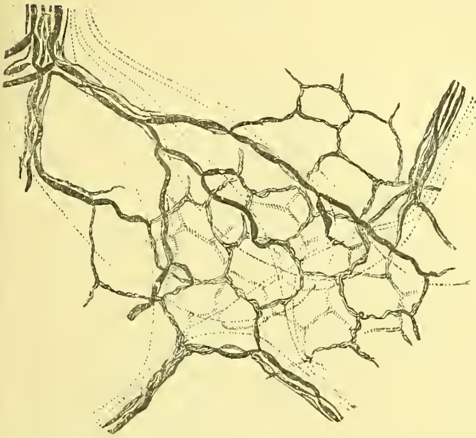
A healthy artery from the kidney of a child, 3 years old, showing muscular fibre cells and longitudinal nuclei of elastic fibres and epithelium within. × 215.

Fig. 9.

Artery from a diseased kidney, showing great irregularity of calibre and degenerated muscular coat. The walls of the vessel have probably completely lost their contractile power. Oil globules and debris are seen in the interior. × 215.

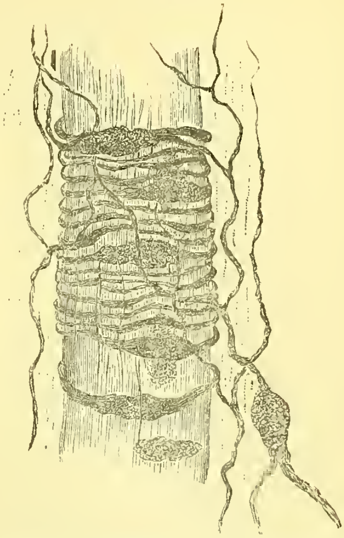
DISTRIBUTION OF NERVES.

Fig. 10.



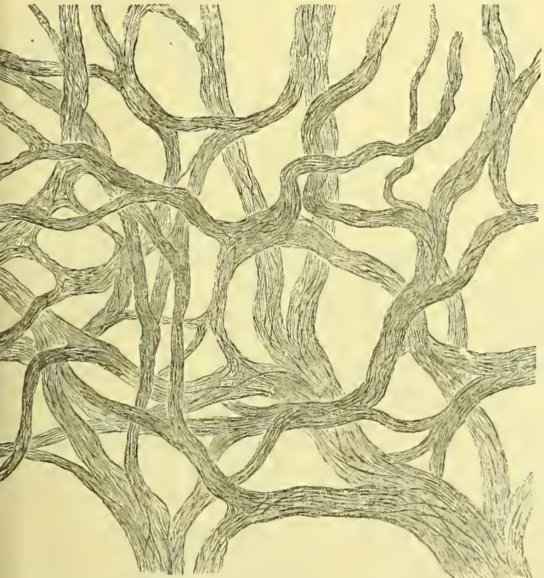
Drawing to show the manner in which plexuses or networks of fine nerve fibres are formed. The course of the numerous nerve currents *to* and *from* the trunks, is indicated by the dotted lines.

Fig. 11.



Portion of very small artery, showing muscular fibre cells and nerve fibres, ramifying in the areolar coat. Frog. × 700.

Fig. 12.



tworks or plexuses of dark-bordered nerve fibres distributed near the free edge f the third eyelid of the common frog. × 220, and reduced to 110 diameters.

Fig. 13.

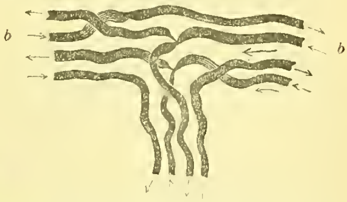


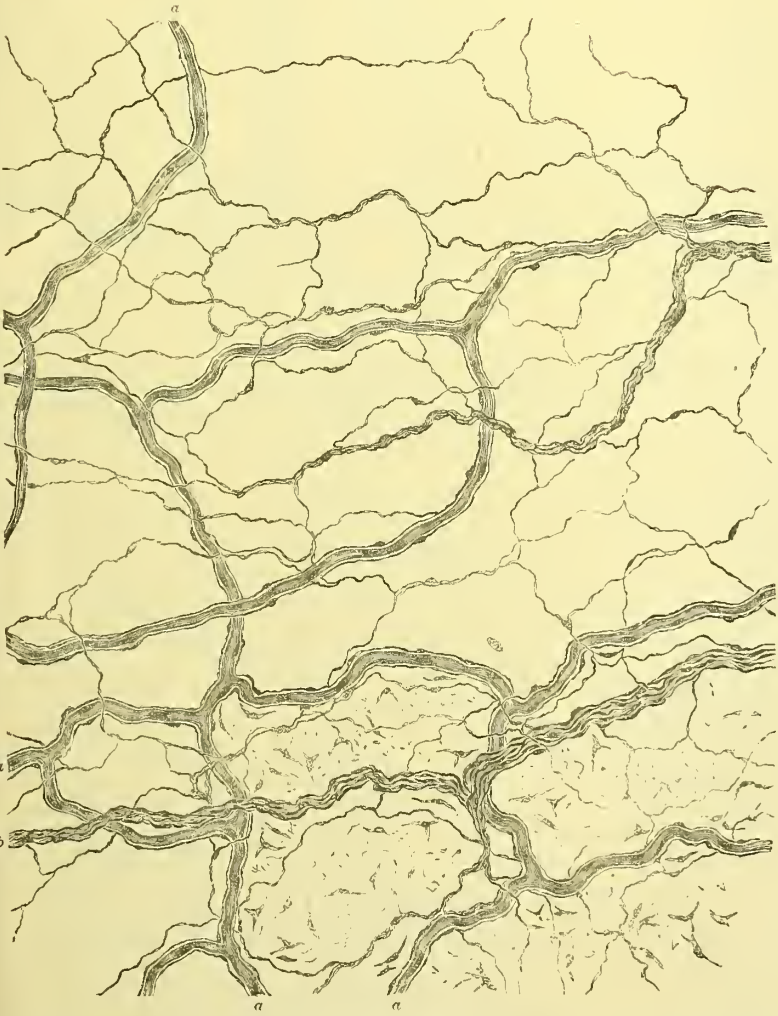
Diagram to show arrangement and division of nerve fibres at the point where a branch leaves the trunk.

Fig. 14.

Nerve fibres distributed to capillary vessel. Frog. In many cases the nerve fibres and their nuclei are closer to the walls of the capillary than represented in the drawing. × 700

PERIPHERAL DISTRIBUTION OF NERVES

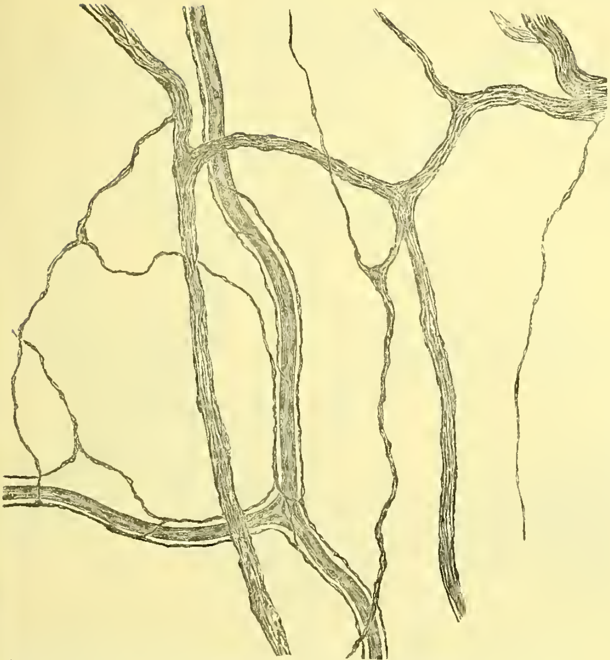
Fig. 15.



Connective tissue covering part of the mylohyoid muscle of the hyla or green tree frog. *a*. Capillary vessels, with their nerve-fibres. *b*. Bundles of fine dark-bordered nerve fibres, from which fine nerve fibres may be traced to the capillaries, and to their distribution in the connective tissue, where they form networks of exceedingly fine but nevertheless compound fibres. This drawing shows the arrangement of nerves in voluntary muscle; the muscular fibres having been removed, the course of the nerves can be readily traced. Magnified 700 diameters and reduced to 110.

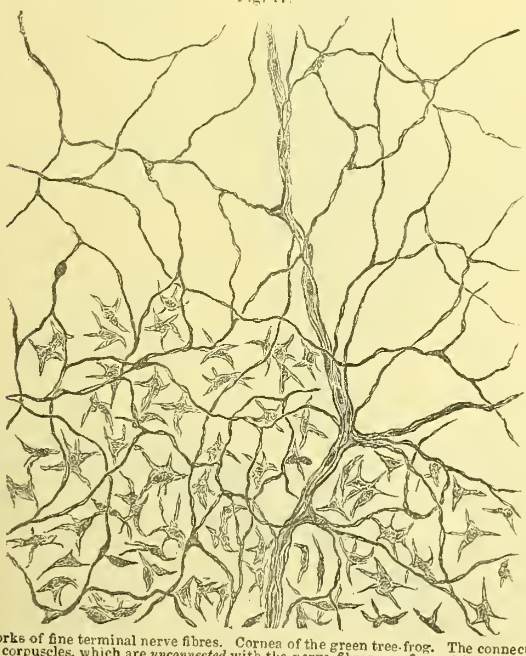
PERIPHERAL DISTRIBUTION OF NERVES.

Fig. 16.



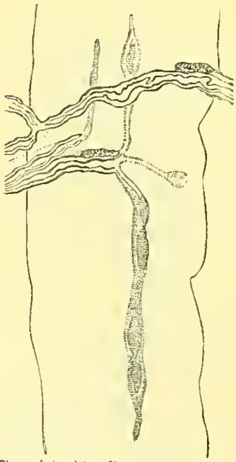
From an interval between the fibres of the mylohyoid muscle of the hyla. Trunks of fine dark-bordered nerve fibres, with fine fibres coming from them, some of which may be traced to the capillaries, while others are distributed to the muscular fibres, which are not represented in the drawing. The arrangement of the nerves supplying the capillary vessel are well seen. See also Fig. 14. × 110.

Fig. 17.



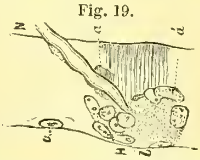
Networks of fine terminal nerve fibres. Cornea of the green tree-frog. The connective tissue corpuscles, which are *unconnected* with the nerve fibres, are figured in the lower part of the drawing only. × 700, and reduced one-half.

Fig. 18.



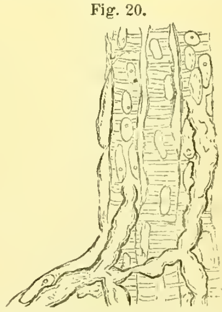
The original 'endknospe' of Kühne.

Fig. 19.



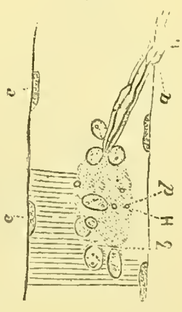
Portion of a muscular fibre. From the eye of a dog. Showing the new form of 'endknospe' discovered by Kühne. × 450.

Fig. 20.



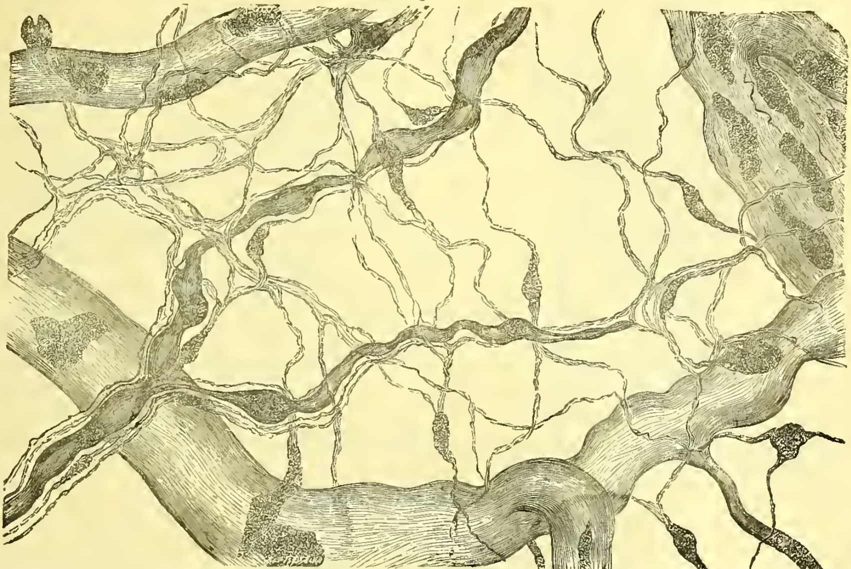
Represents the nerves in what Kölliker has termed 'nodular swellings.' After Kühne. Here a broad dark-bordered fibre is represented as passing into a narrow muscular fibre, a conclusion obviously erroneous. Breast muscle, frog. × 450.

Fig. 21.



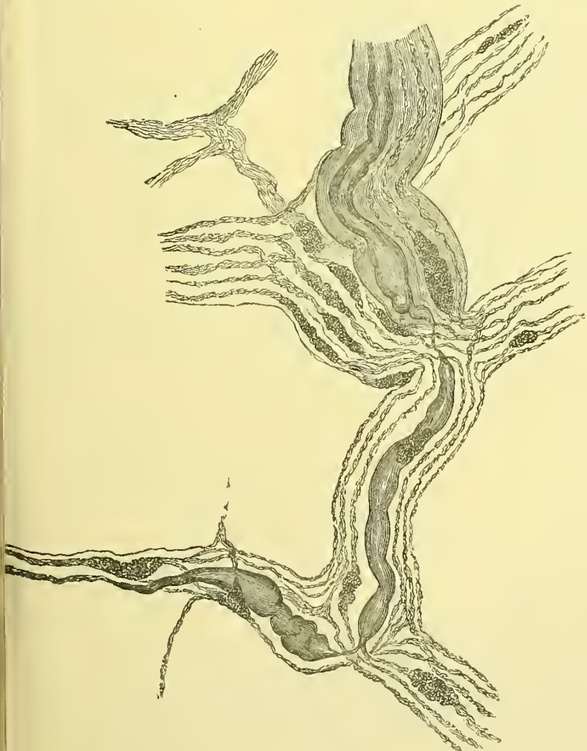
New form of 'endknospe' of Kühne, in muscular fibre from psoas of a rabbit. × 450.

Fig. 22.



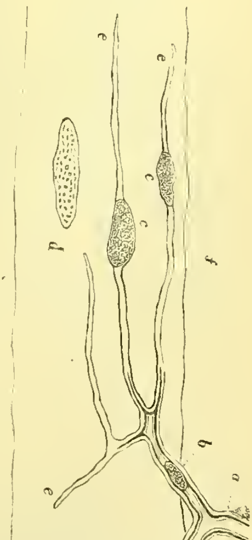
Portion of bladder of common frog, showing the termination of a dark bordered nerve fibre, in fine pale nucleated nerve fibres, which form a network, extending over every part of the organ. This network, which is probably terminal, ramifies over or amongst all the tissues of which the bladder is composed. × 700.

Fig. 23.



anching and division of dark bordered nerve fibre near terminal branches, and bundles fine fibres. Several nuclei are seen in connection with both sets of fibres. All dark-rdered nerve fibres become pale nucleated fibres, like these, before the ultimate distribution is reached. From the bladder of frog. × 700.

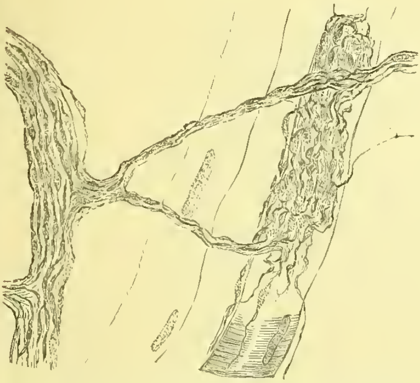
Fig. 24.



A part of one of Kölliker's figures representing the *termination* of a dark-bordered tubular nerve fibre on a muscular fibre of the cutaneous muscle. Frog. In my specimens these fine fibres can be followed for a much greater distance and exhibit no ends, *e*.

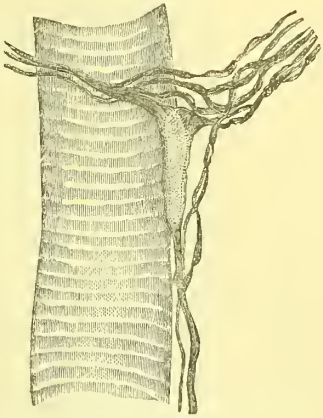
TERMINAL RAMIFICATION OF THE NERVES IN VOLUNTARY MUSCLE.

Fig. 25.



Nerve tuft on the sarcolemma of a muscular fibre. Cameleon. Nerve fibres are seen passing *out of* as well as into the 'nerve tuft.'

Fig. 26.

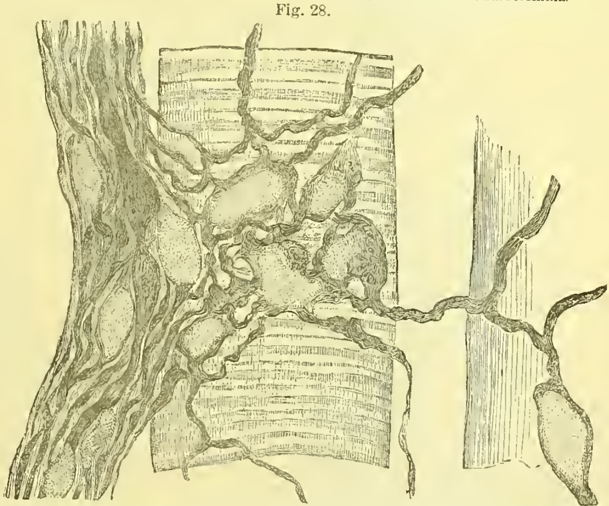


Nerve fibres distributed to elementary muscular fibre. Cameleon. × 3000, and reduced half. This is a very simple form of 'nerve tuft,' clearly external to the sarcolemma.

Fig. 27.

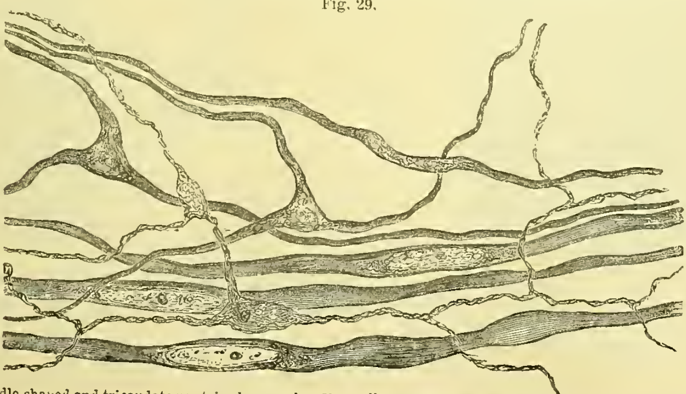
Nerve tuft on the surface of sarcolemma of muscular fibre of which the sarcous material is ruptured. × 215.

Fig. 28.



The intimate structure of a very simple nerve tuft on a muscular fibre of the cameleon. It will be observed that the nerve fibres are continuous throughout, and that the whole is on the surface of the sarcolemma. × 3000. This 'nerve tuft' is as it were but a compound network.

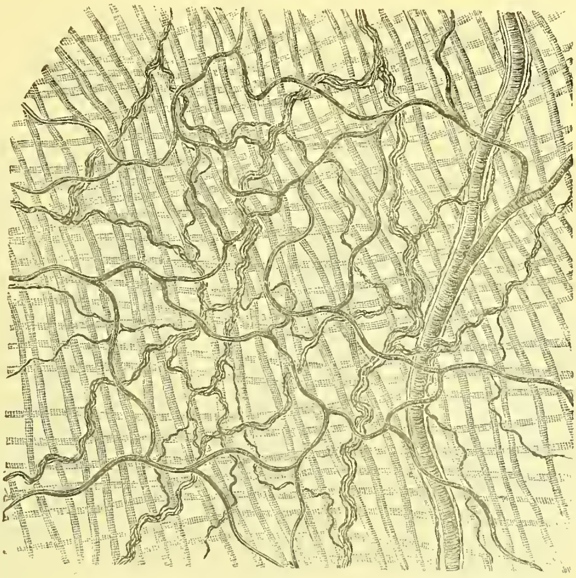
Fig. 29.



Spindle-shaped and tricaudate unstriped muscular fibre cells, with the fine nerve fibres distributed to them. Bladder of the hyla × 900.

TERMINAL RAMIFICATION OF NERVES IN VOLUNTARY MUSCLE.

Fig. 30.

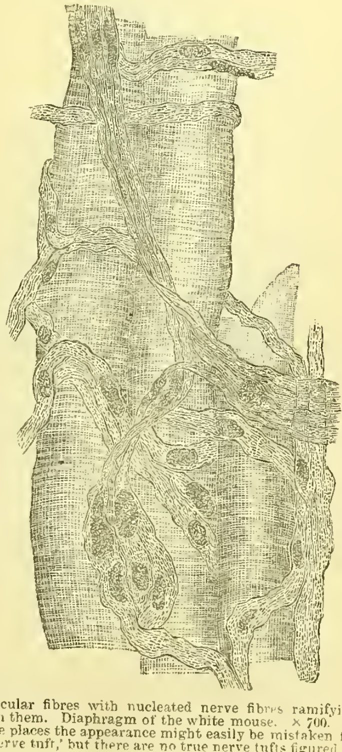


Mylohyoid muscle of the hyla, showing fine muscular fibres not wider than blood corpuscles, capillary vessels, and networks of fine dark-bordered nerve fibres. × 130, and reduced to 65 diameter.

Fig. 31.

Striped muscle, showing the way in which it tapers to its tendon, with fine nerve fibres, from the summit of a papilla. Tongue of the hyla. *a*, fine nerve fibre. *b*, germinal matter, or nucleus of nerve fibre. × 1800.

Fig. 32.



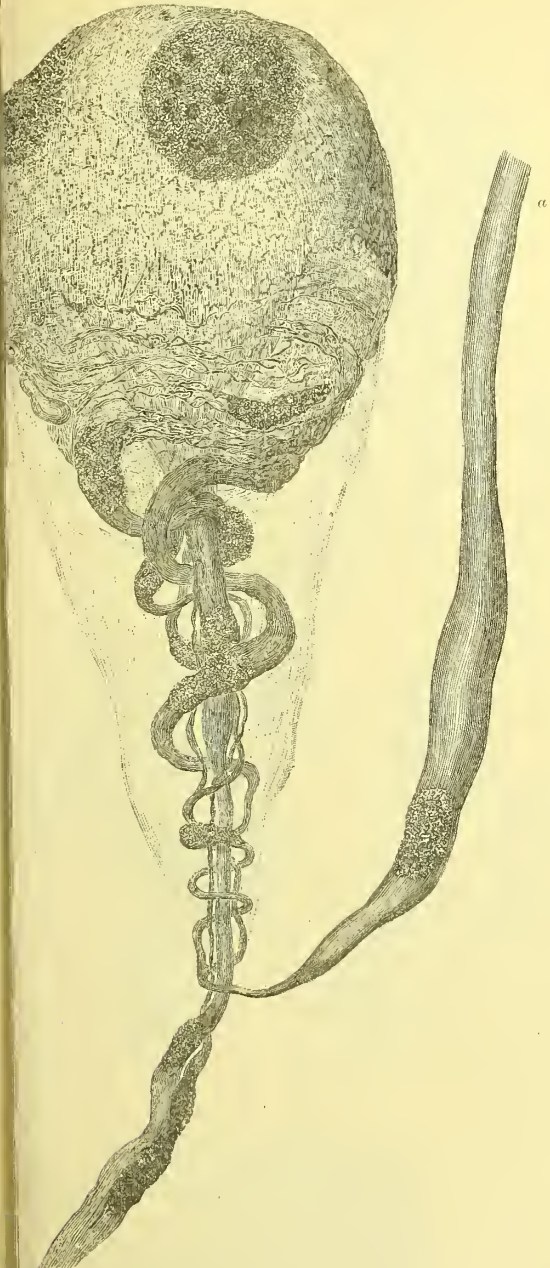
Muscular fibres with nucleated nerve fibres ramifying upon them. Diaphragm of the white mouse. × 700. In some places the appearance might easily be mistaken for a 'nerve tuft,' but there are no true nerve tufts figured in this specimen.

FINEST NERVE FIBRES IN VOLUNTARY MUSCLE.

Fig. 33.

Distribution of finest nucleated nerve fibres to the elementary muscular fibres of the mylohyoid muscle of the little green tree-frog (hyla arborea). Drawn on the block by the author, from a specimen magnified 1800 diameters (the first twenty-fifth made by Messrs. Powell and Lealand). The diameter of each muscular fibre corresponds to that of a human red blood corpuscle. Many of the nuclei of the nerves are very closely applied to the sarcolemma, and might easily be mistaken for the nuclei of that tissue.

Fig. 34.



Ganglion cell isolated. From the hyla. The *straight fibre,* it will be observed, is continuous from the central part of the cell, while the *spiral* fibre is prolonged from its circumference. The matter of which the body of the cell is composed passes into the fibre. The fibre continuous with the spiral fibre, *a*, is a true dark-bordered nerve fibre and in many cases the straight fibre has the same character. It will be observed that the fibres prolonged from tbe cell pass in *opposite directions*. × 1800. Jan., 1863.

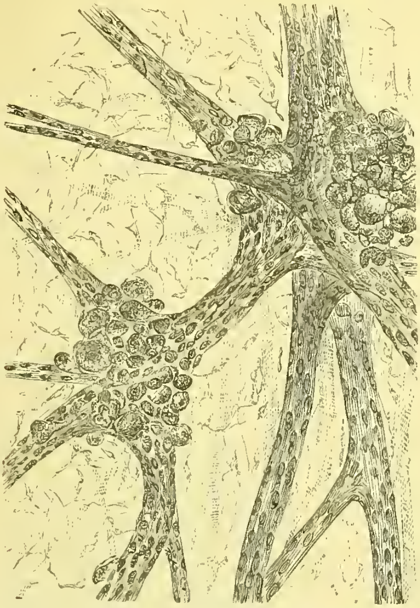
Fig. 35

Fully formed ganglion cell, with very distinct straight and spiral fibre. Common frog. × 700.

Fig. 36.

Fully-formed ganglion cell. Hyla. The arrangement and connections of the spiral fibre, with numerous nuclei, are very distinct. Observe the oil globules in the upper part of the cell. × 700.

Fig 37.

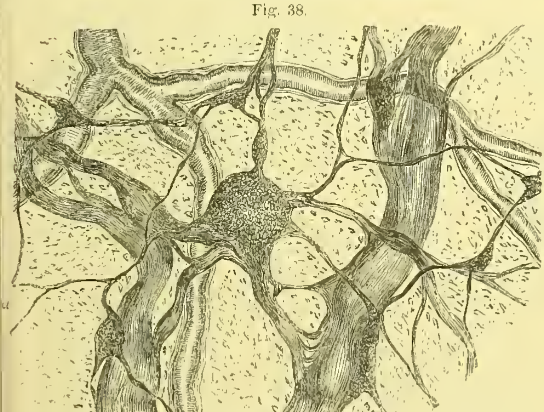


Portions of two ganglia, with connecting nerve trunks. From the submucous areolar tissue of the small intestine. × 215.

Fig. 39.

Ganglion from the pelvis of the kidney of a boy 3 years of age, showing small arteries and capillaries, nerve cells and bundles of nerve fibres. × 215.

Fig. 38.

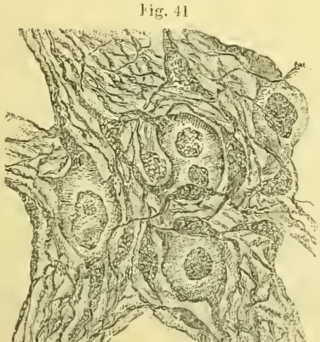


Ganglia and large bundles of nerve fibres. Hilus of kidney. Young pig. *a*, a small artery. × 20.

Fig. 40.

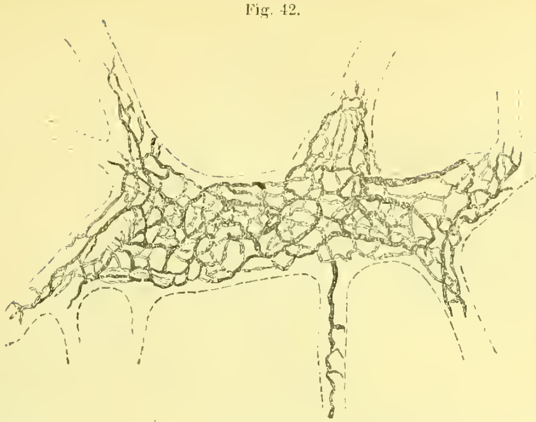
The lower part of a ganglion cell, with the nerve fibres running into it. The spiral fibre divides at the lower part of the figure into one *dark-bordered fibre* and two fine fibres. Observe the nuclei in connection with the nerve fibres near their origin from the cell. × 1800.

Fig. 41



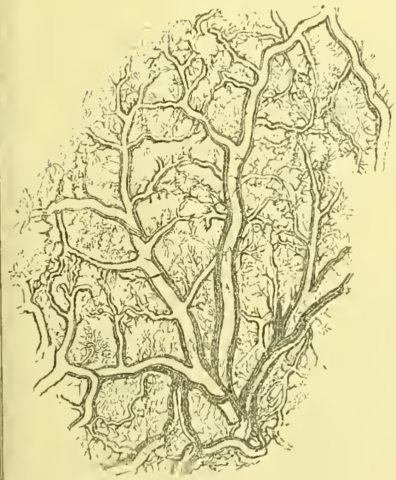
A small portion of the small ganglion seen in Fig. 39, but magnified 700 diameters, showing ganglion cells and their connection with the nerve fibres.

Fig. 42.



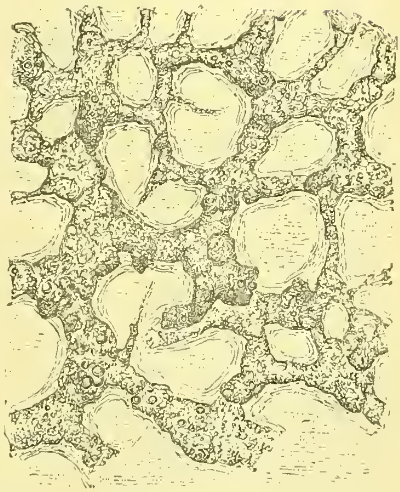
Lymphatics injected with Prussian blue. From the portal canal. Liver. Ox. × 15.

Fig. 43.



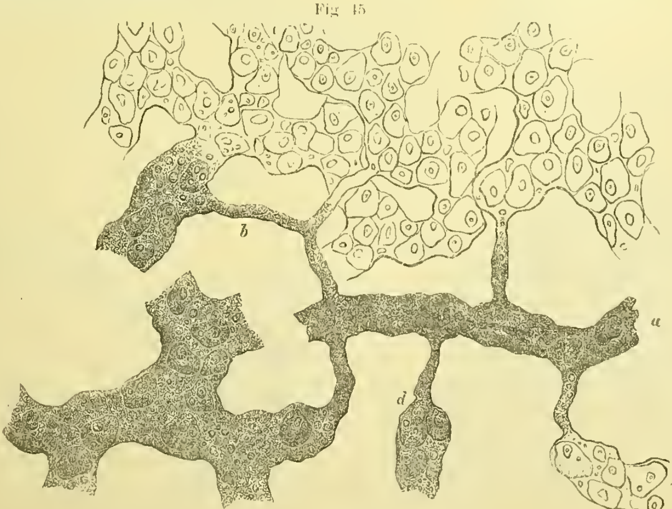
Vessels of gall bladder. The arteries injected with vermilion are accompanied by two veins injected with white, and this arrangement extends even to the smallest ramifications. Natural size.

Fig. 44.



Cell containing network, near the centre of the lobule. Human liver. The capilliaries were dilated to twice their normal diameter. × 215.

Fig. 45.

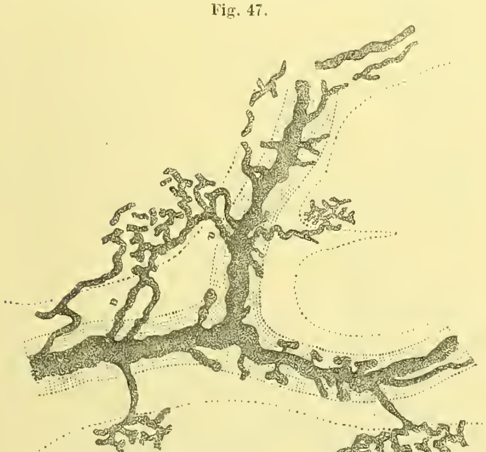


Connection between duct and cell-containing network as proved by injection: *a*, small trunk, giving off several branches; *b*, distended by injection which has reached and entered the cell containing network. × 215.

Fig. 46.

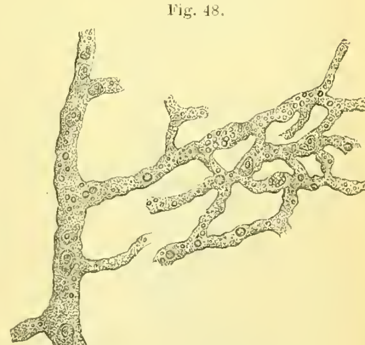
Interlobular duct, with parietal sacculi and branches of communication. Human fœtus. *a*, cell containing network. The tinting shows where the injection had penetrated. × 29.

Fig. 47.



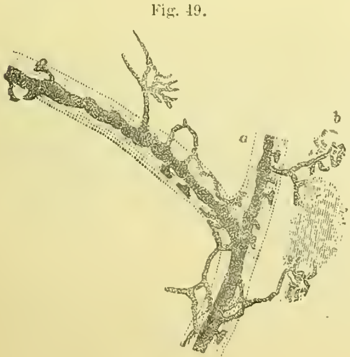
Interlobular duct and branches to cell containing network. Fœtal calf. × 42.

Fig. 48.



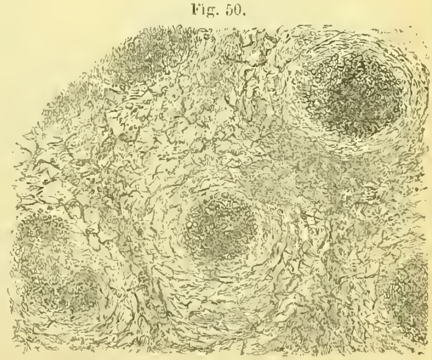
Superficial portion of the cell-containing network of the lobule of the liver. × 215.

Fig. 49.



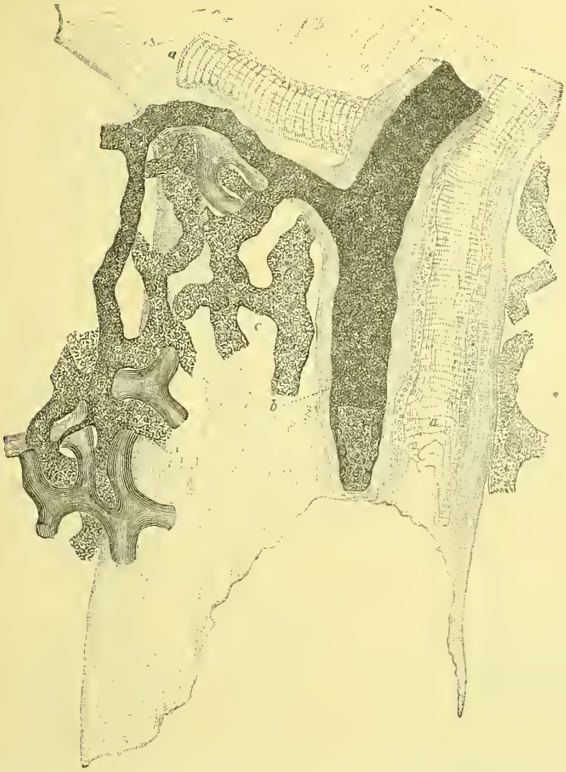
From human fœtus. Smaller branches than represented in Fig. 47. × 42.

Fig. 50.



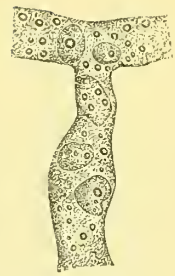
Cirrhosed liver, showing the wasted tubes of the cell containing network of the outer parts of the lobules. Human. × 20.

Fig. 51.



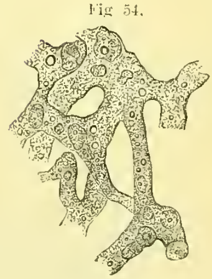
A small portal canal from the seal's liver. The large vessel is the *portal vein* injected with gelatine. *a* is the *artery* uninjected, and *b* the *duct* injected with *Prussian* blue, which has filled the finest ducts, and passed into the cell containing network *c*. × 215.

Fig. 53.



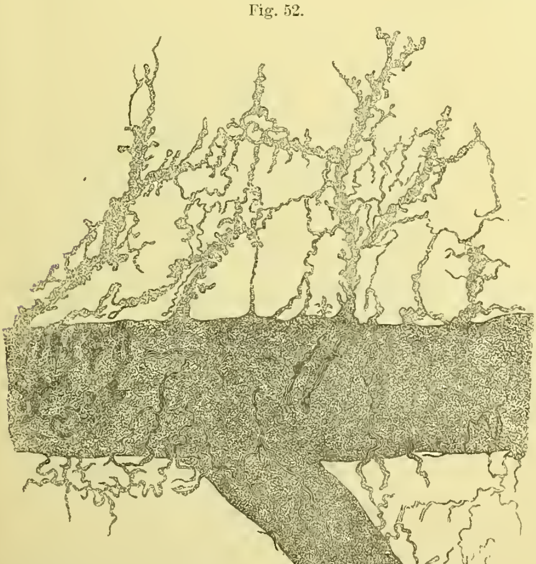
Cell containing network, pig, injected. × 215.

Fig. 54.



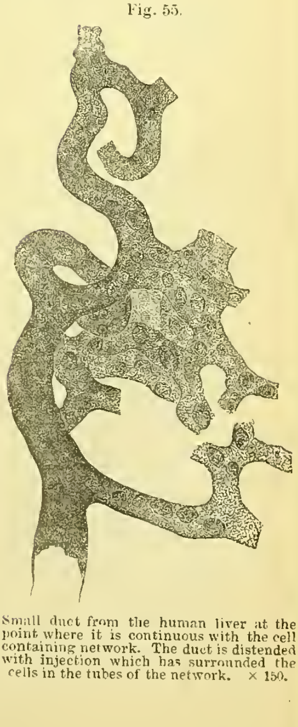
Cell containing network, pig, injected. × 215.

Fig. 52.



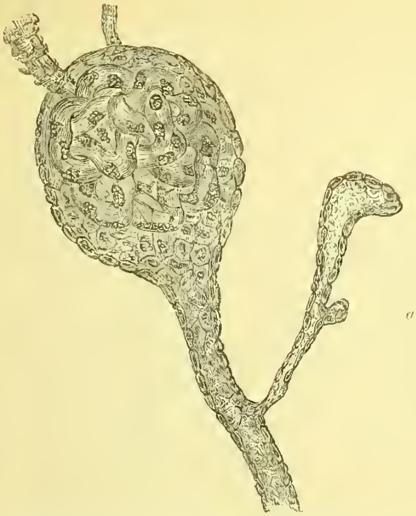
Interlobular duct with lateral appendages and inter-communicating vasa aberrantia. Human. × 8.

Fig. 55.



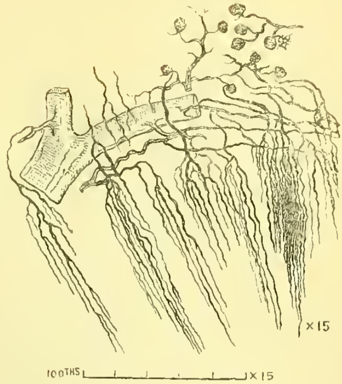
Small duct from the human liver at the point where it is continuous with the cell containing network. The duct is distended with injection which has surrounded the cells in the tubes of the network. × 150.

Fig. 56.



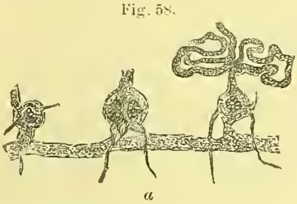
Malpighian body and portion of a uriniferous tube, with remarkable diverticulum. Female newt. At *a*, a bud projects from the diverticular tube as if a branch were growing from it. × 130.

Fig. 57.



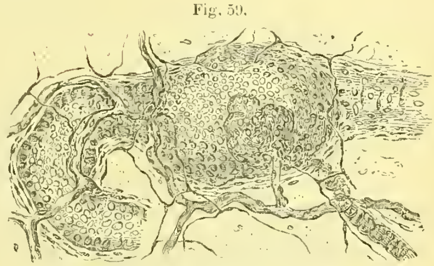
Vasa recta in the pyramidal portion, and Malpighian bodies in the cortical portion of the human kidney. At about the point of union between cortical and medullary portions of the kidney.

Fig. 58.



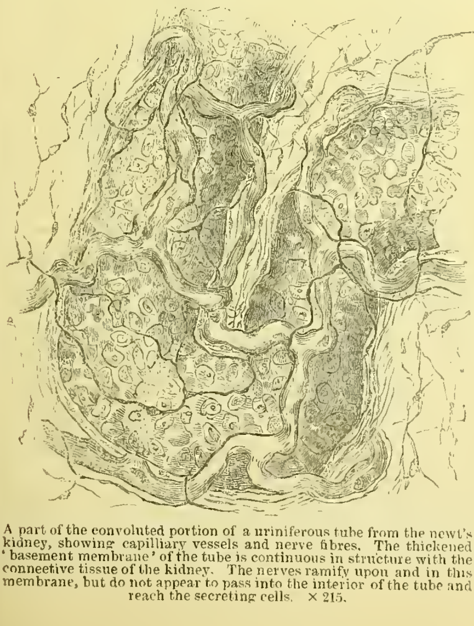
Tube containing spermatozoa, showing connection with uriniferous tubes and Malpighian bodies. One of the latter (*a*) is double. Male newt. × 30.

Fig. 59.



Malpighian body and tube of the newt's kidney. × 130.

Fig. 60.



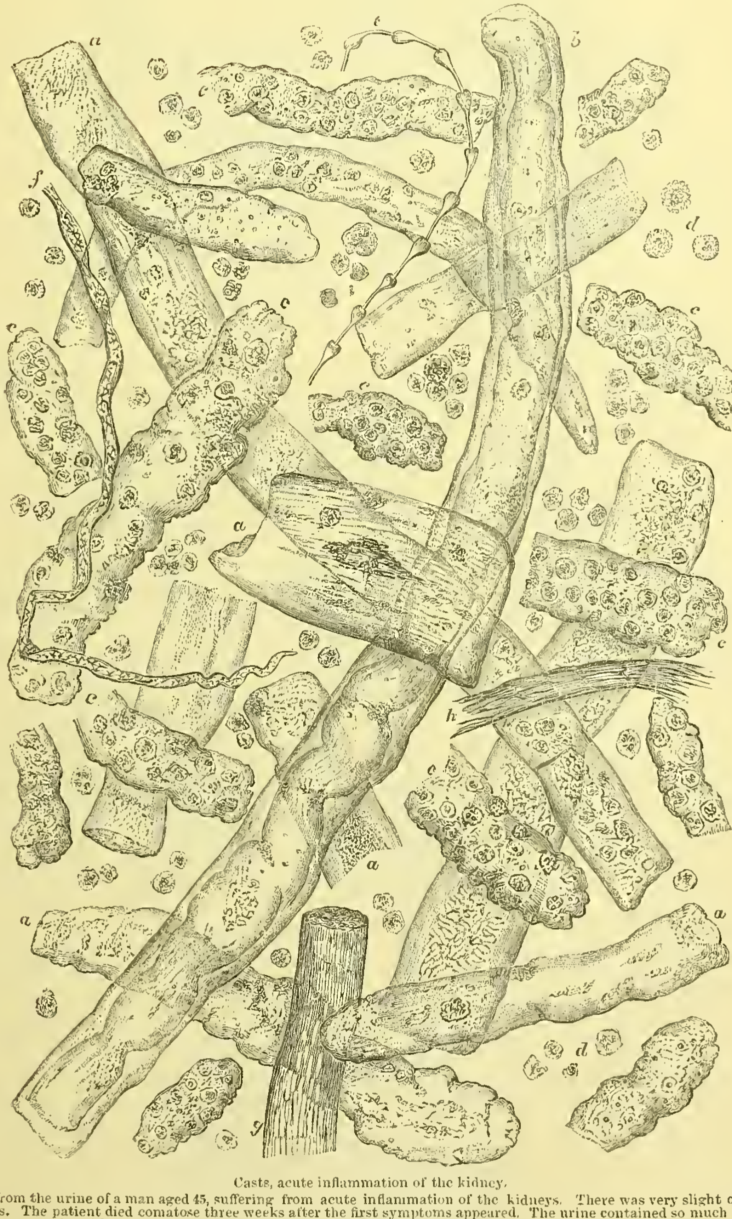
A part of the convoluted portion of a uriniferous tube from the newt's kidney, showing capilliary vessels and nerve fibres. The thickened 'basement membrane' of the tube is continuous in structure with the connective tissue of the kidney. The nerves ramify upon and in this membrane, but do not appear to pass into the interior of the tube and reach the secreting cells. × 215.

Fig. 61.

Elastic tissue from the walls of the air-cells expectorated by a patient suffering from phthisis, at a very early stage of the disease. × 215.

CASTS OF THE URINIFEROUS TUBES.

Fig. 62.



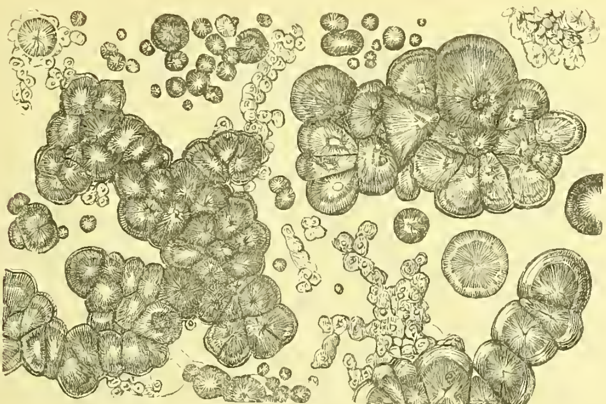
Casts, acute inflammation of the kidney.

Casts from the urine of a man aged 45, suffering from acute inflammation of the kidneys. There was very slight œdema of the legs. The patient died comatose three weeks after the first symptoms appeared. The urine contained so much albumen that it became perfectly solid upon the application of heat and after the addition of nitric acid.

a, perfectly transparent wax-like casts. The shading should be more faint than in the drawing. *b*, a very long wax-like cast, consisting of material deposited at two different periods; the original cast in the interior was probably forced a certain distance further down the uriniferous tube, or perhaps in the wide straight portion, when a new layer of the coagulable material was deposited around it. *c*, casts filled with cells closely resembling pus corpuscles, but somewhat larger. *d*, the same cells free in considerable number; the greater part of the deposit consisted of these cells. *e*, portion of feather. *f*, piece of cotton fibre. *g*, portion of human hair. *h*, flax fibre. × 215.

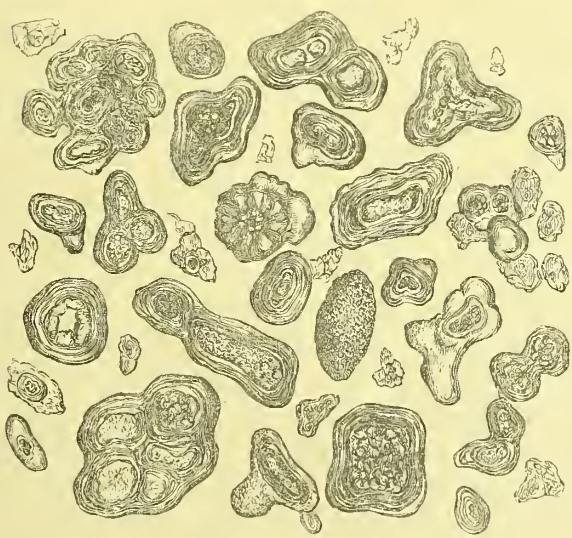
LEUCINE, CALCULI, DUMB-BELLS.

Fig. 63.



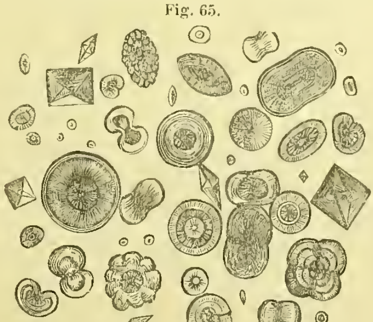
Well-formed crystals of leucine from urine. × 215.

Fig. 64.



Microscopic calculi, consisting of oxalate of lime passed in immense numbers by a gentleman suffering from symptoms of renal calculus. × 215.

Fig. 65.



Octahedra, spherical, and dumb-bell crystals of oxalate of lime from the urine. The largest crystals are in fact microscopic calculi. × 215

N.B.—The specimens marked thus *, are exhibited by themselves at a separate table.